

- POWELL, J. A. & J. A. DE BENEDICTIS. 1995. Foliage feeding Lepidoptera of *Abies* and *Pseudotsuga* associated with *Choristoneura* in California, pp. 168–215. In Powell, J. A. (ed.), Biosystematic studies of conifer-feeding *Choristoneura* (Lepidoptera: Tortricidae) in the western United States. Univ. Calif. Publ. Entomol. 115; 275 pp.
- STEINER. 1990. Butterflies of the San Francisco Bay Area. Unpubl. M.S. Thesis, Calif. State Univ., Hayward. 93 pp.

JERRY A. POWELL, *Essig Museum of Entomology, University of California, Berkeley, California 94720, USA.*

Received for publication 1 November 1995; revised and accepted 13 May 1996.

Journal of the Lepidopterists' Society
51(2), 1997, 179–184

DIURNAL LEPIDOPTERA OF NATIVE AND RECONSTRUCTED PRAIRIES IN EASTERN MINNESOTA

Additional key words: surveys, species richness, vagility.

Prairie butterflies are subjects of increasing conservation concern. Their habitat has been greatly diminished, and their ability to survive on managed sites and to colonize new sites or recolonize old ones is in doubt (Opler 1991). In this paper I report on and compare the diurnal Lepidoptera communities of both native and reconstructed prairies in Minnesota.

I collected insects from the flowers of 58 forb species in four native prairie sites and four prairie reconstructions (former agricultural areas recently replanted to prairie) during the summers of 1990, 1991 and 1992. The sites are described in Table 1. Insects were collected between 0900 h and 1600 h on sunny or partly cloudy days when the temperature was between 20° and 35° C. Collections were made from late May to late September. I made one 15 min aerial net collection of insects on the flowers of each forb species with at least 100 flowers or inflorescences open, for a total of 507 collections from all forb species in all sites over the three summers. Thus, the number of collections made from a site was closely related to the number of forb species present in populations large enough to produce 100 or more flowers. Although only a small fraction of the Lepidoptera present on a site can be sampled by daylight collections, many of the species of conservation concern are diurnal.

The 507 collections yielded 3702 insects representing 305 species; 295 of these were identified at least to genus (Reed 1995). There were 118 Lepidoptera individuals representing 28 species: 24 butterflies and four diurnal moths (Table 2). Insect vouchers are deposited in the University of Minnesota Insect Museum, and plant vouchers are in the University of Minnesota Herbarium.

Collections in native sites produced greater species richness than in reconstructed sites: 73 individuals and 21 species in 218 15-min collections from native sites, compared to 45 individuals and 16 species in 289 collections from reconstructions. Five of the 28 species collected were described as prairie obligates by Orvig (1992): *Callophrys gryneus* (Hubner), *Hesperia l. leonardus* Harris, *H. l. pawnee* Dodge, *Polites origines* (Fabr.) and *Satyrus edwardsii* (Grote & Robinson) and an additional four species were described as remnant-restricted by Panzer et al. (1995): *Euphyes conspicua* (Edw.) *Harkenclenus titus* (Fabr.), *Speyeria aphrodite* (Fabr.) and *Thorybes pylades* (Scudder). Of these nine species, eight were collected from native sites only, none from reconstructions only, and one was collected from both native and reconstructed sites. Of the 19 species not considered site-restricted, four were collected from native sites only, seven from reconstructions only, and eight from both native and reconstructed sites (Table 3).

Management practices do not appear to account for the differences in species presence among sites. There are no obvious differences in management between native sites and reconstructions as a group: the large sites are burned in sections, while the small sites

TABLE 1. Descriptions of Minnesota prairie sites at which Lepidoptera collections were made. Area column gives sizes of entire site/specific area where collections were made. Plant abbreviations: 1, *Achillea millefolium*; 2, *Agastache foeniculum*; 3, *Allium canadense*; 4, *Amorpha canescens*; 5, *Anemone canadensis*; 6, *Aquilegia canadensis*; 7, *Aster ericoides*; 8, *Aster ontariensis*; 9, *Aster oolentangiensis*; 10, *Aster sericeus*; 11, *Aster simplex*; 12, *Berteroa incana*; 13, *Campanula rotundifolia*; 14, *Chrysopsis villosa*; 15, *Cirsium arvense*; 16, *Cirsium discolor*; 17, *Coreopsis palmata*; 18, *Crepis tectorum*; 19, *Dalea purpurea*; 20, *Dalea villosa*; 21, *Desmodium canadense*; 22, *Erigeron strigosus*; 23, *Gadium boreale*; 24, *Grindelia squarrosa*; 25, *Helianthus rigidus*; 26, *Helianthus tuberosus*; 27, *Helicopsis helianthoides*; 28, *Liatris aspera*; 29, *Liatris punctata*; 30, *Liatris pycnostachya*; 31, *Lithospermum canescens*; 32, *Lupinus perennis*; 33, *Melilotus alba*; 34, *Melilotus officinalis*; 35, *Mirabilis nyctaginea*; 36, *Monarda fistulosa*; 37, *Nepeta cataria*; 38, *Penstemon grandiflorus*; 39, *Phlox pilosa*; 40, *Potentilla arguta*; 41, *Potentilla recta*; 42, *Pycnanthemum virginianum*; 43, *Ratibida pinnata*; 44, *Rosa blanda*; 45, *Rubus occidentalis*; 46, *Rudbeckia hirta*; 47, *Solidago canadensis*; 48, *Solidago nemoralis*; 49, *Solidago rigida*; 50, *Solidago speciosa*; 51, *Stachys palustris*; 52, *Sysirinchium canpestre*; 53, *Trifolium pratense*; 54, *Verbena hastata*; 55, *Verbena stricta*; 56, *Vernonia fasciculata*; 57, *Vicia americana*; 58, *Zizia aurea*.

Site	County: location	Prairie type	Area, hectares	Date Planted	Management, last burn	Surroundings	Forbs on site	No. of visits/ collections
Reconstructions								
Afton State Park (ASP)	Washington: NE 1/4 Sect. 10, T27N R20W	mesic	4.8/4.8	1981	mowing, then burning 1989	old fields, woods, oak savanna remnant	19, 36, 43, 46, 54	12/17
Carpenter Nature Center (CARP)	Washington: NE 1/4 Sect. 8, T27N R20W	mesic	32.4/16.2	1988- 1991	mowing, then burning of sections, then	corn and soybeans	1, 2, 7, 11, 15, 16, 19, 22, 25, 26, 27, 30, 34, 36, 40, 41, 43, 44, 46, 47, 49, 50, 51, 53, 55, 58	27/89
Crow Hassan Park Reserve (CHR)	Hennepin: NW 1/4 Sect. 19, T120N R23W	sand- mesic	243/10	1976- present	burning by sections 1991	Restored deciduous woods	1, 2, 3, 4, 5, 7, 9, 10, 14, 17, 19, 25, 26, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39, 40, 43, 44, 46, 47, 49, 50, 52	23/107

TABLE 1. (continued)

Site	County: location	Prairie type	Area, hectares	Date Planted	Management, last burn	Surroundings	Forbs on site	No. of visits/ collections
Long Lake Regional Park (LLRP)	Ramsey: SE 1/4 Sect. 17, T30N R23W	xeric- mesic	2.8/2.8	1987	burning; 1992	Oak savanna remnant; wetland, lawns	1, 2, 3, 4, 7, 9, 10, 11, 12, 14, 18, 19, 20, 21, 22, 24, 25, 27, 33, 34, 36, 38, 42, 46, 47, 48, 49, 50, 58	12/76
Native prairie sites								
Afton Remnant (AREM)	Washington: N 1/2 Sect. 35, T28N R20W	bluff/ mesic	1.6/1.6	—	brush cutting and burning since 1987; 1989	St. Croix bluff; deciduous woods	1, 2, 4, 9, 16, 36, 37, 42, 46, 47, 48, 50, 54	12/49
Cedar Creek Natural History Area (CC)	Anoka: S 1/2 Sect. 34, T34N R 23W	sand	60.7 /5	—	burning by sections, 1990	oak savanna	4, 9, 19, 25, 28, 31, 36, 38, 39, 42, 46, 47, 48, 49, 51,	21/62
Point Douglas Cemetery (CEM)	Washington: SE 1/4 Sect. 5, T27N R20W	mesic	0.4/0.4	—	brush cutting and burning since 1988; 1989	corn, soybeans, part of CARP planted in 1991	7, 9, 11, 21, 23, 25, 26, 27, 36, 43, 44, 47, 49, 50, 57	21/50
Lost Valley State Natural Area (LV)	Washington: S 1/2 Sect. 21 and N 1/2 Sect. 22, T27N R20W	bluff	40.5/7	—	brush cutting burning by sections since 1991; 1992	Old field, woods, hay field	1, 4, 6, 7, 8, 9, 10, 13, 16, 25, 28, 29, 36, 37, 42, 43, 45, 47, 49, 50, 56, 58	21/57

TABLE 2. Scientific and common names of Lepidoptera collected in this study. Nomenclature follows Scott (1984), Opler & Krizek (1984) and Covell (1984).

Hesperiidae

Atrytone logan (Edw.), Delaware Skipper
Euphyes conspicua (Edw.), Black Dash
Euphyes vestris (Boisd.), Dun Skipper
Hesperia leonardus leonardus Harris, Leonard's Skipper
Hesperia leonardus pawnee Dodge, Pawnee Skipper
Polites coras (Cr.), Peck's Skipper
Polites origines (Fabr.), Crossline Skipper
Polites themistocles (Latr.), Tawny-Edged Skipper
Wallengrenia egeremet (Scudder), Broken Dash
Epargyreus clarus (Cr.), Silver Spotted Skipper
Thorybes pylades (Scudder), Northern Cloudy Wing

Pieridae

Colias eurytheme Boisd., Orange Sulphur
Colias philodice Godart, Clouded Sulphur

Lycaenidae

Celastrina ladon (L.), Spring Azure
Satyrrium edwardsii (Gr. & Rob.), Edwards' Hairstreak
Callophrys gryneus (Hubner), Olive Hairstreak
Harkenclenus titus (Fabr.), Coral Hairstreak

Nymphalidae

Phyciodes tharos (Drury), Pearl Crescent
Nymphalis milberti (Godart), Milbert's Tortoiseshell
Vanessa cardui (L.), Painted Lady
Speyeria aphrodite (Fabr.), Aphrodite Fritillary
Speyeria cybele (Fabr.), Great Spangled Fritillary
Cercyonis pegala (Fabr.), Wood Nymph
Asterocampa celtis (Boisd. & Lec.), Hackberry Butterfly

Sphingidae

Hemaris diffinis (Boisd.), Snowberry Clearwing
Hemaris thysbe (Fabr.), Hummingbird Clearwing

Noctuidae

Alypia octomaculata Fabr., Eight-Spotted Forester

Ctenuchidae

Cisseps fulvicollis (Hubner), Yellow-Collared Scape Moth

(AREM, CEM, ASP and LLRP) are burned all at once. The ASP and CARP reconstructions were mowed for two years following planting, but now are managed by burning. Brush cutting is done as needed but does not replace burning on any site.

It is possible that the reconstructed sites do not provide suitable habitat for these obligate species. The reconstructions tend to be more mesic than the most species-rich native sites (CC and AREM), and five of the eight prairie obligates are reported to be restricted to xeric sites by Panzer et al. (1995): *Polites origines* and *Hesperia l. leonardus* to xeric prairie; *Harkenclenus titus* to xeric/mesic prairie; *Satyrrium edwardsii* to savanna; and *Thorybes pylades* to sand savanna. *Hesperia leonardus pawnee* and *Callophrys gryneus* also are found in xeric areas (Orwig 1992). Only two of the obligate species collected are reported by Panzer et al. from mesic sites: *Euphyes conspicua* from sedge meadow and

TABLE 3. Number of individual Lepidoptera species on each prairie site, and their nectar plants. Numeric plant abbreviations follow those given in Table 1. Superscript 1 = restricted to prairie habitats (Orwig 1992). Superscript 2 = high or moderate remnant reliance (Panzer et al. 1995).

Species	Native sites				Reconstructions				Nectar Plants
	AREM	CC	CEM	LV	ASP	CARP	CHR	LLRP	
<i>Alypia octomaculata</i>							1		34
<i>Atrytone logan</i>		4	1		2	3	2		15, 36, 39, 46, 55
<i>Asterocampa celtis</i>						1			36
<i>Callophrys gryneus</i>	2			1					42
<i>Celastrina ladon</i>	1								1
<i>Cercyonis pegala</i>							1	1	1
<i>Cisesepts fulvicollis</i>	2	1	6		1	4	2	1	1, 9, 28, 42, 46, 47, 48, 49, 50
<i>Colias eurytheme</i>		1		1	1	1	5		10, 11, 28, 29, 33, 46, 48
<i>Colias philodice</i>			1	5			1		9, 10, 25, 28
<i>Epargyreus clarus</i>	2				1				1, 36
<i>Euphyes conspicua</i> ²		1							39
<i>Euphyes vestris</i>	1	5			1				1, 36, 42, 46
<i>Harkenclenus titus</i> ²		4							28, 42
<i>Hemaris diffinis</i>	1		1			3			1, 36, 55
<i>Hemaris thysbe</i>	1	1							36
<i>Hesperia l. leonardus</i> ^{1,2}		2							28, 31
<i>Hesperia leonardus pawnee</i> ¹	2								16
<i>Nymphalis milberti</i>				1					8
<i>Phyciodes tharos</i>							1		1
<i>Polites coras</i>							1		38
<i>Polites origines</i> ^{1,2}	1								36
<i>Polites themistocles</i>		1							36
<i>Satyrrium edwardsii</i> ^{1,2}	4	11							1, 4, 42, 46
<i>Speyeria aphrodite</i> ²		2		1		1			28, 36
<i>Speyeria cybele</i>							1		36
<i>Thorybes pylades</i> ²	1	1							1, 39
<i>Vanessa cardui</i>			3			4	1	1	1, 14, 27, 28, 50, 53, 55
<i>Wallengrenia egeremet</i>					1	1	1		36

Speyeria aphrodite from mesic prairie (*S. aphrodite* was collected from the mesic reconstruction CARP—the only obligate individual found on a reconstruction). Beyond these associations with general prairie types, specific interactions with foodplants (both larval and adult), or larval-tending ants may be required for establishment of certain species, as has been demonstrated for other rare Lepidoptera species (Arnold 1983, Cushman & Murphy 1993). *Callophrys gryneus* may be absent from the reconstructions due to the absence of its larval foodplant, eastern red cedar (*Juniperus virginiana*) (Opler & Krizek 1984).

Alternatively, the obligate species may not have reached these reconstructions yet. Butterfly populations in some fragmented habitats have diminished mobility (Dempster 1991), and Cushman and Murphy (1993) suggest that dispersal ability is especially limited among lycaenids. Mobility may be influenced by species-specific behavior, such as reluctance to leave larval foodplants (Arnold 1983). Colonization of new habitat patches by these Lepidoptera may be an infrequent event that occurs during “rare years of explosive dispersal” as described by Ehrlich and Murphy (1987) for *Euphydryas editha*. More study of the basic biology and mobility of each species is required before we can predict whether prairie obligate butterflies will be able to colonize prairie reconstructions.

This study was funded in part by a grant from the Non-game Wildlife Division of the Minnesota Department of Natural Resources. Field assistance was funded by a Research Explorations for Teachers grant to the University of Minnesota Curriculum and Instruction Department. I thank Dave Andow, Theresa Leahy, Bill Miller, Susan Weller and the site managers for all their help. I especially appreciate the thorough reading and professional attitudes of the reviewers.

LITERATURE CITED

- ARNOLD, R. A. 1983. Ecological studies of six endangered butterflies (Lepidoptera, Lycaenidae): island biogeography, patch dynamics, and the design of habitat preserves. Univ. Calif. Publ. Entomol. 99:1–161.
- COVELL, C. V., JR. 1984. A field guide to the moths of eastern North America. Houghton Mifflin, Boston. 496 pp.
- CUSHMAN, J. H. & D. D. MURPHY. 1993. Susceptibility of lycaenid butterflies to endangerment. Wings (Xerces Society) 17:16–21.
- DEMPSTER, J. P. 1991. Fragmentation, isolation and mobility of insect populations, pp. 143–154. In Collins, N. M. & J. A. Thomas (Eds.), The conservation of insects and their habitats. Academic Press, London.
- EHRlich, P. R. & D. D. MURPHY. 1987. Conservation lessons from long term studies of checkerspot butterflies. Cons. Biol. 1:122–131.
- GREAT PLAINS FLORA ASSOCIATION. 1986. Flora of the Great Plains. Univ. Kansas Press, Lawrence, Kansas. 1402 pp.
- OPLER, P. A. 1991. North American problems and perspectives in insect conservation, pp. 9–32. In Collins, N. M. & J. A. Thomas (Eds.), The conservation of insects and their habitats. Academic Press, London.
- OPLER, P. A. & G. O. KRIZEK. 1984. Butterflies east of the Great Plains. Johns Hopkins University Press, Baltimore. 294 pp.
- ORWIG, T. T. 1992. Loess hills prairies and butterfly survival: opportunities and challenges, pp. 132–135. In Smith, D. D. & C. A. Jacobs (Eds.), Proceedings of the Twelfth North American Prairie Conference. Univ. Northern Iowa, Cedar Falls, Iowa.
- PANZER, R., D. STILLWAUGH, R. GNAEDINGER & G. DERKOVITZ. 1995. Prevalence of remnant-reliance among the prairie and savanna-inhabiting insects of the Chicago region. Natural Areas Journal 15:101–116.
- REED, C. C. 1995. Insects surveyed on flowers in native and reconstructed prairies (Minnesota). Restoration and Management Notes 13:210–213.
- SCOTT, J. A. 1986. The butterflies of North America: a natural history and field guide. Stanford Univ. Press, Stanford, California. 585 pp.

CATHERINE C. REED, *Entomology Department, 219 Hodson Hall, University of Minnesota, Saint Paul, Minnesota 55108, USA.*

Received for publication 20 December 1994; revised and accepted 12 March 1996.

Journal of the Lepidopterists' Society
51(2), 1997, 184–187

YOU CAUGHT WHAT IN YOUR BACKYARD?

Additional key words: *Electrostrymon angelia*, *Ministrymon azia*, *Dryas iulia*, Florida, dispersal.

What butterflies are in your back yard? This question has been asked before in the pages of the *Journal* (Howe 1959) and many subsequent notes. Howe identified 64 butterfly species on a nine-acre plot in Kansas, at the time a truly impressive feat. We also